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ABSTRACT

The effect of variations in the organization of information and in contextual features upon comprehension of prose was tested using four tasks. Organization was varied to contrast hierarchical information structures and list information structures, and to test the effect of linking the structural components of the passage into a conceptual framework. Contextual variables which were investigated included length, content (abstract or concrete), amount of time for reading, reading achievement, sex, and previous knowledge about passage content. The four comprehension tasks were immediate free recall, recognition of a factual detail, recognition of the main idea, and recognition of an inference. A fractional design for 32 high school students was used to investigate the organizational and contextual variables within a single experiment. The results suggested that different dimensions of organization and context may affect performance on the four tasks. (AA)

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TASK-DEPENDENCY IN COMPREHENSION OF PROSE

Arlene Bonnie Tenenbaum

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ABSTRACT

The effect of variations in the organization of information and contextual features upon comprehension of prose was tested in multiple tasks. The four tasks were (1) immediate, free recall and recognition of (2) a factual detail, (3) the main idea, and (4) an inference. A fractional design for 32 high school students was used to accommodate many aspects of organization and context, heretofore dispersed, in one experiment. The results suggest that performance on these four tasks may vary as a function of different dimensions of organization and context.

OBJECTIVES

The purpose of this research was to compare the effects of variations in the organization of information and in the context surrounding prose upon comprehension in four different tasks. Some of the variables and tasks in this investigation have been studied in single experiments or in a series of experiments. A fractional design was selected for this research to examine the effect of many variables upon multiple tasks in one experiment.

THEORETICAL FRAMEWORK

Organization of information: The organization of information in prose has been analyzed by categories and attributes (Frase, Crothers), syntactical trees (Winograd), grammatical cases (Norman), types of inferences (Frederiksen, Rieger), literary features (Grimes), difficulty of propositions (Kintsch), and partitioning of semantic concepts (Deutsch). In all of these representations one dimension of organization structures topics, details, and conclusions in prose and another dimension links or connects the structural components into a conceptual framework.

Some researchers expected that the hierarchical structure so helpful in improving recall of lists would also enhance comprehension of prose. Only when passages were quite simple did a hierarchical structure prove superior. Moreover, when task requirements governed the selection of a structure in mechanical assembly, comprehension was improved by a list structure (Wright). In this study two alternative structures, hierarchical and list, were manipulated.

Most linking schema in prose have been limited to piecemeal intersentential connections or expanded to elaborate semantic concepts. Teachers cannot attend to either extreme for routine preparation of materials. A linking procedure to mediate these approaches was varied in this study.

Contextual features: Context was very broadly defined in this project to subsume characteristics of the materials (length and subject matter contents), learning conditions (amount of time for reading), and student differences (reading achievement, sex, and previous knowledge). Such variables have been so widely dispersed in many experiments or specified differently that effects simply cannot be assessed. For instance, the contents of the passages have ranged from chessmen, fishes, tavern brawl, nebulae to the news of the day. This diversity compounds the difficulty of disentangling the effects of organization from context.

Task differentiation: In most previous studies only a variant of a recall task was used to assess the differential impact of vaiations in organization and context. In classrooms, however, students perform tasks, such as selecting the main idea, remembering a factual detail, and drawing inferences. In addition to an immediate, free recall task, comprehension in these latter tasks was also measured in this study. They were designed as multiple-choice questions.

METHOD

Design: Nine substantive factors, each with two levels, were varied in a mixed

design. (The use and effect of control variables will not be reported here.) A ¼ fraction of a 2^8 design with four trials for each subject was used for the within-subjects portion and a 1/16 replicate of a 2^8 design for the between-subjects portion (Winer, 1971). Higher order interactions are not interpretable. The total number of subjects was 32, one subject and one subject replication.

Variables: Organization of information: Two factors specified the organization of a passage. One factor structured the information into a hierarchy or list. In the hierarchical structure the major details in a passage, five sentences with distinct facts, were categorized into two major groups; the categories were marked by a paragraph indentation and a topic and concluding sentence. In the list structure the major details were presented in the same order as in the hierarchical condition, but all cues for grouping the details were eliminated. Each major detail was signalled by a paragraph indentation.

The function of the second organizational variable was to link all of the structural elements into a conceptual framework. The conceptual linkage supplied a rule about all the information in a passage; this rule could predict a relationship among the structural elements (either hierarchical or list) and integrate the information. Such a linkage may be a statement about the interdependency of forces in making decisions about land use or a principle in social epedemiology. The effect of this linkage was tested by embedding the full statement or phrases from it in each element in the passage or by explicating it only in the final sentence of the passage.

Context: The passages were further differentiated by length (200 or 400 words) and contents (abstract, cultural geography or concrete, physical geography). A set of 32 passages was constructed to balance these two contextual features and the organizational variables. Three subject differences were also controlled, sex, reading achievement (high or moderate), and previous knowledge about the passage contents. The effect of previous knowledge was simulated by giving subjects a paragraph before each passage. The information in this paragraph was specified by two variables, amount of information matching the passage itself (much or little) and form of information (conceptual linkage or details). Finally, the amount of time for reading each passage (sufficient or unrestricted) was varied.

Procedures: The subjects, high school seniors, were tested in four groups, depending upon the allotted amount of reading time, and paid $5.00 for the two-hour session. Subjects completed a warm-up and four trials. Each trial contained the following sequence of components: (1) paragraph with previous knowledge; (2) passage; (3) recall task; (4) recognition of a factual detail; (5) recognition of the main idea; (6) recognition of an inference; and (7) distractor task to inhibit carryover between trials. Seven minutes were allowed for the recall task and seven for the three recognition tasks. Note that recall preceded recognition.

Dependent measures: Recall: Subjects were instructed to write down all they could remember about the passage. The amount of details in the recall was compared to the amount of details in the passage.

Recognition: These three multiple choice questions were scored correct/incorrect. The measure of factual detail was stated exactly the same as in the passage. Recognition of the main idea called for the categorization of the

details and the conceptual linkage. To respond correctly to the inference task subjects had to apply the linkage to connect two contiguous details.

Contrast scores: A contrast score was generated from each of the above measures and used in univariate analyses of variance as derived measures. These scores are normalized and directly comparable. Correlations (subjects x measures) among these contrasts substantiated the statistical independence of the dependent measures.

RESULTS

Organization of information: Performance on the four comprehension tasks varied as a function of different dimensions of organization. The list structure modestly increased the amount recalled, F (1,16) =7.7, p .05, but the hierarchical structure enhanced recognition of the main idea, F (1,16) =12.6, p .01, and, to a lesser degree, of a factual detail, F (1,16) =6.3, p .05. Recognition of an inference was greatly improved by embedded linkages, F (1,16) = 57.6, p .01; the placement of linkages did not influence performance on any other task. The two organizational variables did not interact on any task.

Context: Contextual influences also played different roles in different tasks. The combination of much/conceptual linkage in the previous knowledge increased the amount of details recalled. No other contextual feature exerted a main effect upon recall.

Several significant interactions among contextual influences appeared on the recognition tasks. High-achieving readers, for instance, scored slightly higher than moderate readers on all recognition tasks. On the inference task length, contents, and linkages interacted. In the case of cultural geography, longer passages aided recognition of inferences.

DISCUSSION

Theory: Significant task-dependent effects were found for both variations in organization and in context. The influence of organization in text upon processes for storing and retrieving information in memory remains problematical (Calfee); although sorely needed, this experiment was not designed to distinguish these two processes. Nonetheless, each dimension of organization facilitated access to information in memory independently (no interaction) for different tasks; structural and linking schema in prose seem to be task-dependent.

The levels of the contextual variables were formulated to tap even extreme effects. For recall, with the exception of previous knowledge the role of time, length, contents, and reading achievement and sex do not appear critical. No prior empirical evidence suggested that recognition tasks would be more susceptible to contextual influences than recall (Griffith; Kintsch). Some control was established over these variables, but interactions involving contents and length limit generalizability. That reading achievement in skilled readers affected comprehension should alert more experimental researchers in prose analysis and information-processing to individual differences.

Educational implications: Just as careful attention could be given to the organization of information in prose as teachers have traditionally treated the actual ideas and tasks. Students cannot be expected to reconstruct a

main idea easily from prose which is inappropriately organized. Similarly, some different contextual features could be considered depending upon the task students must perform. The recall task, for instance, can be likened to the familiar classroom injunction, "Read this chapter for tomorrow and we'll discuss it." In that sort of task reading achievement appears less critical than in recognition tasks.

Students read many other types of prose than the expository contents in this study and perform many other types of comprehension. Future work could be directed towards this variegation and examine the effects of organization and context.

APPENDIX

DESIGN FACTORS

I. Within-subjects

A. Organization of information

1. Structure: hierarchical/
   list
2. Linkages: embedded/
   in conclusion

B. Contextual influences

3. Previous knowledge-amount: a lot/
   a little
4. Previous knowledge-form: rule/
   instance
5. Length of passage: short/
   long
6. Position of each passage within two contents: Land & Flood or Corn & Pigs/
   Flood & Land or Pigs & Corn

C. Control

7. Trial position: Trial 1 and 2/
   Trial 3 and 4/
   Trial 1 and 3/
   Trial 2 and 4

II. Between-subjects

A. Contextual influences

8. Time of reading: short/
   long
9. Order of two contents: physical geography first/
   cultural geography first
10. Reading achievement: high/
    moderate
11. Sex: male/
    female

B. Blocking correspondence

12. Blocks: first 8 blocks/
    last 8 blocks/
    first and third 4 blocks/
    second and fourth 4 blocks/
    1, 2, 5, 6, 9, 10, 13, 14/
    3, 4, 7, 8, 11, 12, 15, 16/
    all odd/
    all even

Numbers 1 - 12 index each factor from the two portions of the total design.

NOTATION FOR ORGANIZATION OF PASSAGE ORGANIZATION

STRUCTURE

Sentences marked (1): introductory generalization
Comment: same in all 4 passages

Sentences marked (2a,2b,2c,2d,2e) in Passage I: hierarchical cues
Comment: after introductory generalization, beginning and ending of paragraphs

Sentences marked (2a,2b) in Passage II: list summaries
Comment: after generalization, first sentence in conclusion

Sentences marked (4a,4b,4c,4d,4e,4f; 4b,c ,4e,f) in Passage I: major details
Comment: subsumed within hierarchies, truncated in conclusion

Sentences marked (4a,4b,4c,4d,4e,4f) in Passage II: major details
Comment: signalled by paragraph indentation; same order as in hierarchical structure but no explicit cues (N.B:not random)

Sentences marked (4d.1) in Passage I and (4d.1,4f.1) in Passage II: subdetails
Comment: not reported here

LINKAGES

Sentences marked (3a,3b) and underlined in Passage I: full statement of conceptual linkage
Comment: placed after 1st hierarchical cue, inter-sentential linking cues (nouns, verbs, transitions), 1st sentence in conclusion

Sentence marked (3a) in Passage II: full statement of conceptual linkage
Comment: placed last in passage; NO underlined phrases because no other linkages in this condition

Passage I (hierarchical/embedded)

City planners consider many factors in deciding about land use (1). These factors can be divided into two major groups, ecological concerns and demographic needs (2a). Yet, all these factors are interdependent and must be weighed and balanced, because they conflict (3a).

One factor, then, is ecological (2b). Some industrial plants, for instance, give out great amounts of air pollution (4a). The kind of industrial plant also depends upon the nature of the soil (4b). Some soils are too soft for heavy industry (4c). Soil structure, moreover, is related to natural features (4d). A lack of large trees, for example, weakens the soil and causes erosion (4d.1). All these ecological concerns must be weighed against the needs of the people (2c).

Another factor in land use is demographic needs (2d). People who work want to get to their jobs quickly to save time for leisure and travel (4e). Unemployed persons, like retired people with much spare time, however, may prefer a shopping center within walking distance rather than a factory (4f). Diverse needs of people are understood by city planners (2e).

Here is an example in land use in which these factors interact and conflict (3b). Only one piece of soil is strong enough for a chemical factory (4b, c). This location, however, is too far from the homes of workers but close to the homes of elderly persons who want shops (4e, f).

Passage II (list/conclusion)

City planners consider many factors in deciding about land use (1). These factors are pollution in the air, the nature of the soil, natural features, access to jobs, and closeness to shopping centers (2a).

Some industrial plants give out great and strong amounts of air pollution (4a). Chemical factories let sulphur dioxide and other harmful irritants into the air.

The structure and nature of the soil usually limits the kind of building that can be put up (4b). Some soils are too soft for high-rise office buildings, for instance (4c).

The presence of certain natural features, such as the amount of large trees, is also important (4d). They cannot be changed easily (4d.1).

People who work want to get to their jobs quickly and easily to save time for leisure and recreational activities like traveling (4e).

Retired people may want to be close to a shopping center (4f). Such centers often include a variety of general and specialized stores as well as postal service and eating facilities (4f.1).

Pollution in the air, the condition of the soil, the presence of natural features, nearness to jobs, and access to shopping centers must be weighed and balanced against each other (2b). All of these factors are interdependent and may cause conflict of interests for city planners (3a).

The following examples show the previous knowledge for the conditions rule/little and instance/much.

Form: rule Amount: a little/

[Builders think about many factors before constructing a new apartment house. They must weigh and balance these factors, because they are interdependent and may conflict. For instance, one possible location may be near a factory where people work but extra money would have to be spent building new sewers. Thus builders study many important aspects before constructing an apartment house.] (In rule/much the last sentence repeats the second sentence in rule/little, i. e., the conceptual linkage in the passage)

Form: instance Amount: much/

[Builders think about many factors before constructing an apartment house. In Boston, for instance, city managers let the Bumblebee Tuna Company plan to build a huge apartment house within a ten minute bus ride to their largest canning factory. As construction began, the builders discovered that it would cost an additional half-million dollars to put pollution devices in the factory to stop chemicals from blackening walls.] (In instance/much two details related to the passage, housing near factory and pollution, are included. In instance/little rusty sewers was substituted for pollution.)

This simulation of previous knowledge provided a preview of the concept or details in the passage but the contents is slightly different in these paragraphs.

People who work want

* a. quick and easy access to their jobs.
  b. quick and easy access to shopping centers.
  c. quick and easy access to factories.
  d. quick and easy access to recreation.

The main idea of this passage is:

* a. City planners weigh conflicting ecological and demographic needs to determine land use.
  b. City planners must evaluate ecological considerations to determine land use.
  c. Demographic needs can diverge from ecological needs in determining land use.
  d. Ecological balance is considered more important than demographic needs in determining land use.

The nature of soil is partially determined by natural features

* a. because a lack of large trees can cause soil erosion.
  b. because a group of large trees can absorb chemicals harmful to the soil.
  c. because some large trees cannot easily be moved.
  d. because certain trees grow only in certain soils.

TABLE 1

Summary of Significant Results for Substantive Factors

Source	Experimental Tasks							
	Recall (Amount of Details)		Recognition: Factual Detail		Recognition: Main Idea		Recognition: Inference	
	F-Ratio	Means	F-Ratio	Means	F-Ratio	Means	F-Ratio	Means
Dimensions of Organization								
Main Effects								
Structure	7.7*		6.3*		12.6**			
Hierarchical		.0036		.91		.81		
List		.0045		.73		.48		
Linkage							57.6**	
Embedded								.86
Conclusion								.50
Interactions								
None								

5a

Table 1 (continued)

Source	Experimental Tasks: Recall (Amount of Details) F-Ratio	Recall (Amount of Details) Means	Recognition: Factual Detail F-Ratio	Recognition: Factual Detail Means	Recognition: Main Idea F-Ratio	Recognition: Main Idea Means	Recognition: Inference F-Ratio	Recognition: Inference Means
Contextual Features								
Main Effect								
Reading Achievement			3.2		4.8*		7.1*	
High				1.75		1.50		1.53
Moderate				1.53		1.09		1.22
Interactions								
Previous Knowledge: Form x Amount	6.2*							
Rule x a Lot		.25						
Rule x a Little		.21						
Instance x a Lot		.17						
Instance x a Little		.21						
Previous Knowledge (form) x Reading Achievement					15.3**		7.1*	
Rule x High						.34		.34
Rule x Moderate						.34		.34
Instance x High						.42		.42
Instance x Moderate						.19		.27

Table 1 (continued)

Source	Experimental Tasks: Recall (Amount of Details) F-Ratio	Recall (Amount of Details) Means	Recognition: Factual Detail F-Ratio	Recognition: Factual Detail Means	Recognition: Main Idea F-Ratio	Recognition: Main Idea Means	Recognition: Inference F-Ratio	Recognition: Inference Means
Contextual Features								
Interactions (continued)								
Previous Knowledge (form) x Sex							14.0**	
Rule x Male								.41
Rule x Female								.28
Instance x Male								.40
Instance x Female								.39
Length x Contents							14.0**	
Long x Physical Geography								.31
Long x Cultural Geography								.36
Short x Physical Geography								.44
Short x Cultural Geography								.27

Table 1 (continued)

Source	Experimental Tasks: Recall (Amount of Details) F-Ratio	Recall (Amount of Details) Means	Recognition: Factual Detail F-Ratio	Recognition: Factual Detail Means	Recognition: Main Idea F-Ratio	Recognition: Main Idea Means	Recognition: Inference F-Ratio	Recognition: Inference Means
Organization x Context								
Linkages x Contents	13.3**							
Embedded x Physical Geography		.17						
Embedded x Cultural Geography		.24						
Conclusion x Physical Geography		.22						
Conclusion x Cultural Geography		.19						
Linkages x Reading Achievement							10.0**	
Embedded x High								.44
Embedded x Moderate								.44
Conclusion x High								.33
Conclusion x Moderate								.17

Note: Each source was analyzed separately. Therefore, the mean square error (residual) was also computed separately for each source, and they are not reported here. The degrees of freedom for each source were 1, 16. The values of the cell means derive from the contrast scores rather than the raw data.

**p < .01 F = 8.5

*p < .05 F = 4.4

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